

CLAIMS

What is claimed is:

1. A chemical-mechanical polishing assembly, comprising:
 - a platen having an outer edge, a top surface, and at least one inlet for introducing fluid to said top surface;
 - a manifold system, entrenched in said top surface and in communication with said at least one inlet, for channeling said fluid about said top surface;
 - a polishing pad disposed over said top surface and having a top pad surface and a plurality of fluid delivery through-holes for introducing said fluid from said manifold system to said top pad surface; and
 - a fluid distribution system, entrenched in said top pad surface and in communication with said through-holes, for substantially uniformly distributing said fluid about said top pad surface, said fluid distribution system comprising:
 - a set of intersecting first grooves defining an array of lands, each of said first grooves having a first cross sectional area, and
 - a plurality of second grooves disposed within each of said lands and communicating with said first grooves, each of said second grooves having a second cross sectional area that is smaller than said first cross sectional area.
2. A chemical-mechanical polishing assembly according to claim 1, wherein said first grooves intersect at right angles.
3. A chemical-mechanical polishing assembly according to claim 2, wherein said second grooves intersect at right angles, and also communicate with said first grooves at right angles.

4. A chemical-mechanical polishing assembly according to claim 3, wherein said first grooves are evenly spaced across said top pad surface at a pitch between about 1.0 inch and about 1.375 inch, and said second grooves are evenly spaced across said lands.

5. A chemical-mechanical polishing assembly according to claim 4, wherein said array of lands consists of a first set of lands that are entirely surrounded by said first grooves, and a second set of land that are partially surrounded by said first grooves and form part of said outer edge, and each of said lands in said first set includes between about seven and about sixteen of said second grooves in a first direction, and between about seven and about sixteen of said second grooves in a second direction perpendicular to said first direction.

6. A chemical-mechanical polishing assembly according to claim 1, wherein each of said second grooves has a depth ranging between about 0.020 inch and about 0.025 inch, and a width ranging between about 0.010 inch and about 0.014 inch.

7. A chemical-mechanical polishing assembly according to claim 1, wherein each of said first grooves has a depth ranging between about 0.055 inch and about 0.060 inch, and a width ranging between about 0.032 inch and about 0.030 inch.

8. A chemical-mechanical polishing assembly according to claim 1, wherein each of said through-holes is disposed within one of said lands with no more than one through-hole per land, thereby enabling said fluid to flow from said through-holes immediately into said second grooves.

9. A chemical-mechanical polishing assembly according to claim 1, wherein said first and second grooves and said manifold system are configured to satisfy the ratios:

$$\Delta P_2/\Delta P_3 > 1 \quad (1)$$

$$\Delta P_2/\Delta P_1 > 1 \quad (2)$$

wherein ΔP_1 is a drop in resistance pressure as said fluid flows from said manifold system to said through-holes, ΔP_2 is a drop in resistance pressure as said fluid flows from said through holes through said second grooves to said first grooves, and ΔP_3 is a drop in resistance pressure as said fluid flows through said first grooves off of said outer edge.

10. A chemical-mechanical polishing assembly according to claim 9, wherein the ratio:

$$\Delta P_2/\Delta P_3 \quad (1)$$

is at least 10.

11. A chemical-mechanical polishing pad, comprising:

a top surface;

a plurality of fluid delivery through-holes for introducing a fluid to said top surface; and

a fluid distribution system, entrenched in said top surface and in communication with said through-holes, for substantially uniformly distributing said fluid about said top surface, said fluid distribution system comprising:

a set of intersecting first grooves defining an array of lands, each of said first grooves having a first cross sectional area, and

a plurality of second grooves disposed within each of said lands and communicating with said first grooves, each of said second grooves having a second cross sectional area that is smaller than said first cross sectional area.

12. A chemical-mechanical polishing pad according to claim 11, wherein said first grooves intersect at right angles.

13. A chemical-mechanical polishing pad according to claim 12, wherein said second grooves intersect at right angles, and also communicate with said first grooves at right angles.

14. A chemical-mechanical polishing pad according to claim 13, wherein said first grooves are evenly spaced across said top pad surface at a pitch between about 1.0 inch and about 1.375 inch, and said second grooves are evenly spaced across said lands.

15. A chemical-mechanical polishing pad according to claim 14, wherein said array of lands consists of a first set of lands that are entirely surrounded by said first grooves, and a second set of land that are partially surrounded by said first grooves and form part of said outer edge, and each of said lands in said first set includes between about 7 and about 16 of said second grooves in a first direction, and between about 7 and about 16 of said second grooves in a second direction perpendicular to said first direction.

16. A chemical-mechanical polishing pad according to claim 11, wherein each of said second grooves has a depth ranging between about 0.020 inch

and about 0.025 inch, and a width ranging between about 0.010 inch and about 0.014 inch.

17. A chemical-mechanical polishing pad according to claim 11, wherein each of said first grooves has a depth ranging between about 0.055 inch and about 0.060 inch, and a width ranging between about 0.032 inch and about 0.030 inch.

18. A chemical-mechanical polishing pad according to claim 11, wherein each of said through-holes is disposed within one of said lands with no more than one through-hole per land, thereby enabling said fluid to flow from said through-holes immediately into said second grooves.

19. A chemical-mechanical polishing assembly according to claim 1, wherein said first and second grooves are configured to satisfy the ratio:

$$\Delta P_2 / \Delta P_3 > 1 \quad (1)$$

wherein ΔP_2 is a drop in resistance pressure as said fluid flows from said through holes through said second grooves to said first grooves, and ΔP_3 is a drop in resistance pressure as said fluid flows through said first grooves off of said outer edge.

20. A chemical-mechanical polishing assembly according to claim 19, wherein the ratio:

$$\Delta P_2 / \Delta P_3 \quad (1)$$

is at least 10.

21. A chemical-mechanical polishing apparatus for planarizing a workpiece surface, comprising:

a platen having an outer edge, a top surface, and at least one inlet for introducing fluid to said top surface;

a manifold system, entrenched in said top surface and in communication with said at least one inlet, for channeling said fluid about said top surface;

a polishing pad disposed over said top surface and having a top pad surface and a plurality of fluid delivery through-holes for introducing said fluid from said manifold system to said top pad surface;

a fluid distribution system, entrenched in said top pad surface and in communication with said through-holes, for substantially uniformly distributing said fluid about said top pad surface, said fluid distribution system comprising:

a set of intersecting first grooves defining an array of lands, each of said first grooves having a first cross sectional area, and

a plurality of second grooves disposed within each of said lands and communicating with said first grooves, each of said second grooves having a second cross sectional area that is smaller than said first cross sectional area; and

a carrier configured to carry and press said workpiece against said polishing pad.

22. A chemical-mechanical polishing apparatus according to claim 21, wherein said first grooves intersect at right angles.

23. A chemical-mechanical polishing apparatus according to claim 22, wherein said second grooves intersect at right angles, and also communicate with said first grooves at right angles.

24. A chemical-mechanical polishing apparatus according to claim 23, wherein said first grooves are evenly spaced across said top pad surface at a pitch between about 1.0 inch and about 1.375 inch, and said second grooves are evenly spaced across said lands.

25. A chemical-mechanical polishing apparatus according to claim 24, wherein said array of lands consists of a first set of lands that are entirely surrounded by said first grooves, and a second set of land that are partially surrounded by said first grooves and form part of said outer edge, and each of said lands in said first set includes between about seven and about sixteen of said second grooves in a first direction, and between about seven and about sixteen of said second grooves in a second direction perpendicular to said first direction.

26. A chemical-mechanical polishing apparatus according to claim 21, wherein each of said second grooves has a depth ranging between about 0.020 inch and about 0.025 inch, and a width ranging between about 0.010 inch and about 0.014 inch.

27. A chemical-mechanical polishing apparatus according to claim 21, wherein each of said first grooves has a depth ranging between about 0.055 inch and about 0.060 inch, and a width ranging between about 0.032 inch and about 0.030 inch.

28. A chemical-mechanical polishing apparatus according to claim 21, wherein each of said through-holes is disposed within one of said lands with no more than one through-hole per land, thereby enabling said fluid to flow from said through-holes immediately into said second grooves.

29. A chemical-mechanical polishing apparatus according to claim 21, wherein said first and second grooves and said manifold system are configured to satisfy the ratios:

$$\Delta P_2/\Delta P_3 > 1 \quad (1)$$

$$\Delta P_2/\Delta P_1 > 1 \quad (2)$$

wherein ΔP_1 is a drop in resistance pressure as said fluid flows from said manifold system to said through-holes, ΔP_2 is a drop in resistance pressure as said fluid flows from said through holes through said second grooves to said first grooves, and ΔP_3 is a drop in resistance pressure as said fluid flows through said first grooves off of said outer edge.

30. A chemical-mechanical polishing apparatus according to claim 29, wherein the ratio:

$$\Delta P_2/\Delta P_3 \quad (1)$$

is at least 10.